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Prospective Memory: A New Focus for Research

Peter Graf [1]

Department of Psychology, University of British Columbia, 2136 West Mall, Vancouver, British Columbia, V6T 1Z4 Canada

and

Bob Uttl

Department of Psychology, Oregon State University, Corvallis, Oregon 97331

Prospective memory is required for many aspects of everyday cognition, its breakdown may be as debilitating as impairments in retrospective memory, and yet, the former has received relatively little attention by memory researchers. This article outlines a strategy for changing the fortunes of prospective memory, for guiding new research to shore up the claim that prospective memory is a distinct aspect of cognition, and to obtain evidence for clear performance dissociations between prospective memory and other memory functions. We begin by identifying the unique requirements of prospective memory tasks and by dividing memory's prospective functions into subdomains that are analogous to divisions in retrospective memory (e.g., short- versus long-term memory). We focus on one prospective function, called prospective memory proper; we define this function in the spirit of James (1890) as requiring that we are aware of a plan, of which meanwhile we have not been thinking, with the additional consciousness that we made the plan earlier. We give an operational definition of prospective memory proper and specify how it differs from explicit and implicit retrospective memory and how it might be empirically assessed.

What is prospective memory (ProM)?[2] Why ask this question, when, according to a commentary by Crowder (1996), ''the loss of the term prospective memory would leave us better off, not impoverished'' (p. 144). In a separate commentary, Roediger (1996) expressed a similarly off-putting sentiment as a question: ''why get excited about this new way [the ProM way] of studying episodic memory?'' (p. 151). Our main purpose for this article is to answer the question ''What is ProM?'' and to respond to the commentaries by Crowder and Roediger.

These commentaries deserve a response, in part because they appeared in the first book that was entirely devoted to ProM (Brandimonte, Einstein, & McDaniel, 1996).

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[1] To whom correspondence and reprint requests should be addressed. Fax: (604) 822-6923. E-mail: pgraf@cortex.psych.ubc.ca.

[2] We use the abbreviation ProM rather than PM because, as noted by Roediger (1996), the latter is too closely associated with primary memory.

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It seems peculiar that despite reaching this publication milestone, two preeminent scholars are still not willing to accept ProM as a distinct form of episodic memory. Did the scores of investigations that were reported or reviewed in Brandimonte et al. not provide a sufficiently strong basis for distinguishing ProM from retrospective memory (RetM)? Is the bleak portrait of ProM by Crowder and Roediger primarily indicative of a failure to communicate a scientifically acceptable definition of ProM? Answers to such questions are likely to foretell the future for ProM research.

It is important to recognize that Crowder and Roediger questioned the specific and limited claim that *ProM is a distinct form of episodic memory.* They did not deny that memory has a prospective function, one that is required for carrying out planned activities, such as taking medication nightly at bedtime or conveying a message on the next encounter with a colleague. The question is whether this function involves distinct structures and processes—a different cognitive system—from that required for episodic RetM tasks.

We maintain that the bleak portrait of ProM by Crowder and Roediger is not warranted because the relationship between ProM and episodic RetM has not yet been adequately specified or investigated. By focusing attention on this relationship, however, Crowder and Roediger have inadvertently underscored the fact that ProM spans a domain that may be as wide as that of RetM. Therefore, it seems that ProM research could benefit by proceeding with a divide-and-conquer strategy similar to that used for RetM research, that is, by postulating distinct subdomains (cf. episodic and semantic memory) and by pursuing more focused research questions and theoretical accounts. For the reasons that made it useful and even necessary to adopt clear subdomain labels and definitions for RetM, we believe that it will be equally useful and necessary in the future for ProM researchers to identify precisely which subdomain is targeted by each investigation.

We follow this prescription in this article in order to draw attention to a subdomain of ProM that seems most directly analogous to James' (1890) *memory proper,* today more generally known as *explicit episodic memory.* Our goal is to identify this subdomain of ProM—herein called *ProM proper* to define precisely how it differs from explicit episodic RetM and to show how it can be operationalized and measured. ProM proper was implicated by Crowder and Roediger's comparisons between ProM and episodic RetM. Therefore, we use their commentaries to highlight problem areas in current ProM research and definitions, to ferret out functions and requirements that are unique to ProM proper, and thereby to set the stage for future investigations that focus on the relationship between ProM proper and explicit episodic RetM.

The Quest for Identity

Roediger (1996) attempted to answer the question ''What is ProM?'' by searching for empirical evidence that some kinds of experimental manipulations, or developmental and neuropsychological variables, have different effects on ProM and RetM task performance. He was disappointed to learn that ''many findings from studies of prospective memory are of the same general kind as from studies of retrospective memory . . . [that] there are no cases of principles emerging that would cause us to change our thinking about how memory works or to believe that prospective tasks

fundamentally differ from retrospective tasks. The manipulated variables (e.g., attention, retention interval, cue distinctiveness) generally have parallel effects on prospective and retrospective tests'' (p. 151). In the absence of solid evidence that ProM differs in a fundamental way from episodic RetM, Roediger concluded by dismissing ProM with the question, ''why get excited about this new way of studying episodic memory?'' (p. 151).

We do not fault Roediger for his summary of the existing evidence on ProM, but we reject—for a variety of reasons—the implications he draws from it. One important reason is that ProM research is still in its infancy and those critical investigations that might yield the evidence stipulated by Roediger have not yet been done. Rather than conduct research to demonstrate that ProM is distinct from episodic RetM, the primary focus of much previous research has been to learn about performance on different types of ProM tasks, such as time- versus event-based tasks (Einstein & McDaniel, 1990; Harris, 1984) or habitual versus episodic tasks (Einstein, McDaniel, Smith, & Shaw, 1998). This type of research is as legitimate as RetM investigations that have compared, for example, performance on recall and recognition tests (e.g., Jacoby, Craik, & Begg, 1979) or performance on word- and picture-fragment completion tests (e.g., Weldon & Roediger, 1987).

We recommend a more cautious interpretation of the existing evidence also because of the methods used for indexing ProM performance in previous investigations. ProM researchers have developed a great variety of methods, but they all have two attributes that limit a conclusive assessment of the relationship between ProM and episodic RetM: they (the existing methods) yield binary data, and performance is not ''process pure.'' To illustrate the first property, consider the prospective task of getting groceries en route home from work. On such a task, performance is scored either a success or a failure. This kind of data tend to be less precise (as an index of underlying processes) and thus more variable than the continuous data obtained from most episodic RetM tasks. Therefore, binary data are not optimal for direct comparisons with the continuous data obtained from standard episodic memory tests.

What we mean by the claim that performance on existing ProM tests is not ''process pure'' is highlighted by our example task, getting groceries en route home from work. We can fail this task either because we did not recollect the plan when driving by the supermarket or because we did not remember the items on the grocery list. It is widely recognized that only the first of these components is clearly prospective (Dobbs & Rule, 1987; Einstein & McDaniel, 1996); the latter seems part of retrospective memory and not different from failing to recollect a list of words upon request. ProM researchers have employed a variety of different strategies for separating these two influences on performance (e.g., varying the RetM load across constant ProM conditions or minimizing the RetM load across different ProM conditions; see Einstein, Holland, McDaniel, & Guynn, 1992; Einstein & McDaniel, 1990). However, until we have solid evidence for the validity of these strategies and a clear understanding of how the pro- and retrospective components interact with each other, we are not able to make definitive claims about ProM. It would seem premature, therefore, to use the existing evidence to argue either for or against the proposal that ProM is distinct from episodic RetM.

A final critical point to be considered in the interpretation of the existing evidence

is the wide range of activities that seem to involve ProM. The prospective function of memory is required for short-term tasks, such as monitoring the tea kettle; for longer term episodic or one-off tasks such as conveying a message on the next encounter with a colleague; as well as for habitual tasks such as taking a prescribed medication nightly at bedtime. The range of these activities is enormous and probably as diverse as the activities involving RetM. However, for RetM, this range is acknowledged to include distinct types of activities and as requiring different memory functions or systems, such as primary versus secondary (James, 1890), episodic versus semantic (Tulving, 1972), and implicit versus explicit (Graf & Schacter, 1985). Researchers have proposed analogous divisions in the domain of ProM (e.g., Einstein & McDaniel, 1996). However, such divisions have not gained widespread acceptance in the ProM literature, and consequently, a careful assessment of methods is required in order to determine what aspect of ProM was targeted by each investigation. Upon careful examination, it may turn out that some aspects of ProM (e.g., the ProM analog to short-term RetM) are not distinct from RetM, while other aspects (e.g., the ProM analog to episodic RetM) are dissociable from it. Roediger did not consider this possibility, and thus, his interpretation of the evidence is ill informed.

Instead of focusing on the available evidence, Crowder examined definitions of ProM, found them indefensible, and concluded that ''the term prospective memory is misleading'' (p. 143)—that we would be better off without it. ProM has been defined in many ways, including as intention memory (Goschke & Kuhl, 1996; Loftus, 1971), remembering intentions (Kvavilashvili & Ellis, 1996), memory for future actions (Einstein & McDaniel, 1996; Mäntylä, 1996), and remembering that something has to be done (Dobbs & Rule, 1987; Maylor, 1996). By these examples, the prospective function of memory is defined by the to-be-remembered content. But a content-based definition is difficult to defend, in part because it raises obvious questions, such as How is memory for plans and intentions different from memory for anything else? and Does a content specific domain of episodic memory require a name of its own? Crowder and Roediger's answer to the latter question was an emphatic no, and we agree with this position.

This position has precedence in the literature. Memory for words, faces, pictures, music, and emotions, for example, are widely recognized as important and interesting content domains of episodic memory, but their investigation has not required or justified postulating new terms or subdivisions of memory. For this reason, it would seem that a different, much stronger foundation is required for claiming that ProM is a distinctive form of memory.

One such foundation was suggested by Winograd's (1988) and others' (e.g., Einstein & McDaniel, 1996; Meacham, 1982; Park & Kidder, 1996) reference to noncognitive components. According to Winograd (1988), ''more than retrospective remembering, prospective remembering overlaps with other areas of psychology not usually regarded as being about memory'' (p. 349) . . . ''prospective remembering is not an isolable act of pure cognition. It is part of ongoing action and such factors as attention, motivation, compliance, vigilance, reward, conflicting goals, and the like are all involved . . . in the analysis of prospective remembering, these non-cognitive factors command our attention early on'' (p. 350).

In his commentary, Crowder (1996) considered whether these noncognitive factors

delineate a clear difference between ProM and RetM. He was not persuaded, and neither are we. Noncognitive factors (e.g., motivation and compliance) are features of the subjects, not of the memory task. We acknowledge that subject features are important for determining performance, most likely on both ProM and RetM tasks. However, there is no evidence or arguments that they (the noncognitive components) establish a clear distinction between ProM and RetM tasks.

Crowder's examination of ProM definitions focused our attention on memory's prospective function and on the requirements of different memory tasks. The latter seem to provide a promising foundation for distinguishing between ProM and RetM.

We see memory's prospective function as connected with the word prospective, with what it means to be a prospector. Prospectors are forward-looking specialists, trained to see beyond the obvious; their core task is to examine the environment for telltale signs of mineral deposits. Typically, the job of unearthing or recovering such deposits is left to the next set of specialists—miners. By analogy, we regard RetM as being concerned with the latter, specialized for recovery operations, whereas unique to ProM is the capacity to see beyond the obvious, to recognize telltale signs (cf. Craik, 1986; Ellis, 1996; Einstein & McDaniel, 1990, 1996). Concretely, if the plan is to buy groceries en route home from work, ProM is required for recognizing the supermarket as relevant to this plan even when attention is focused elsewhere (e.g., on driving and talking on the phone). If the plan is recollected in the presence of the appropriate cue, RetM is engaged to recollect the items on the grocery list. The cues[3] given for a memory test seem to function like the telltale signs sought out by prospectors. RetM begins with cues, with recognized telltale signs, and it uses these as guides for recovering prior episodes, events, and experiences (i.e., hidden knowledge deposits). By contrast, the prospective function of memory is required for situations where telltale signs have to be recognized so that recovery operations can be initiated.

These characterizations of ProM and RetM tasks lend themselves to a task analysis. Any memory task may be defined as a request or a comparable situation (defined by the experimenter, the subject, ongoing activities, or the environment) that occurs in a particular context and that calls for, elicits, or recruits a particular type of responding. Consistent with this definition, any memory task is describable objectively in terms of cues, instructions, a context (e.g., spatial and emotional), and a response type (see Graf & Birt, 1996). A difference in a single property can be sufficient for distinguishing between two types of memory tasks. In many previous investigations of implicit and explicit memory, for example, the memory tests differed only in terms of the instructions given to subjects. That is, both tests used the exact same cues, required the same response type, and were given in the same context (e.g., Graf & Mandler, 1984; Schacter & Graf, 1986). Similarly, we can conceive of ProM and RetM tasks that make use of the same cues and context. The context might be a laboratory room

[3] ProM researchers have made a distinction between event- and time-based tasks (Einstein & McDaniel, 1996; Harris, 1980). The difference between these tasks may be defined in several ways. In this article, we underscore that time can also functions as a cue for searching memory (e.g., ''What did you do yesterday at 3 PM?''). We regard time as a less intrusive cue than, for example, an oven alarm that signals the end of the bake cycle.

and a cue for remembering might be the experimenter giving the subject a printed form showing the initial letters of previously studied words. When cues and context are held constant in this manner, this serves to isolate the crucial differences between ProM and RetM tasks, in this case, the exact instructions given to subjects. For the RetM task, the instructions—delivered together with the test form—might direct subjects to write previously studied words on the test form. For the ProM task, the instructions—which would have been given earlier in the experiment—might be that ''upon receiving the recall form later on, please request a red pen from me and use it to write your name on the test form.''

Table 1 summarizes the core similarities and differences between ProM and two familiar RetM tasks—implicit and explicit. We make the assumption that the cues, the context, and the response type are held constant. If so, what differs between the tasks is, first, whether at the time of testing subjects are alerted to the cues and directed to work with them in a target-task relevant manner, and second, whether subjects are specifically instructed to use the cues in a manner that is relevant to the prior study or planning phase. For all RetM tasks, subjects are aware or are made aware of the cues at the time of testing and they are given specific instructions on how to work with them. As the table shows, the critical difference between explicit and implicit tests is that for the former, subjects are specifically instructed to use the cues in a study-trial relevant manner. That is, they are informed to use the cues as aids for recollecting previously studied words. For implicit memory tests, subjects also are instructed on how to use the cues (e.g., subjects may be told to complete the cues with any words that come to mind), but the instructions do not draw attention to specific prior learning events and experiences (Graf & Schacter, 1985). By contrast, for ProM tasks, subjects may or may not be aware of the cues (the cues may be central or incidental to an ongoing task); what is critical is that at the time of testing, subjects are not instructed to work with the cues in a ProM-task-relevant manner. To illustrate, when driving by the supermarket, nothing alerts us to pay attention to this cue, and no one instructs us that this cue is relevant to a previously formed plan (e.g., get the groceries en route home from work). Instead, in ProM tasks the cues appear as a natural part of other tasks or situations, they are embedded in other ongoing activities. *What is unique about ProM tasks is that they require identifying or recognizing cues as telltale signs of previously formed plans and intentions when they (the cues) occur as part of ongoing thoughts, actions, or situations* (Craik, 1986;

TABLE 1
Properties of Explicit, Implicit, and Prospective Memory Tests

Type of memory test	Cues provided on test	At test, subjects are alerted to cues & instructed to work with them in a task-relevant manner	At test, subjects are alerted to the study/planning phase relevance of cues
Retrospective			
Explicit	Yes	Yes	Yes
Implicit	Yes	Yes	No
Prospective	Yes	No	No

Einstein & McDaniel, 1996; Kidder, Park, Hertzog, & Morrell, 1997; Kvavilashvili, 1987; Maylor, 1993; Mäntylä, 1996; Park & Kidder, 1996).

By contrast to Crowder and Roediger, we are excited about the ProM way of studying memory because of this unique requirement of ProM tasks because it seems highly likely that they recruit a different set of perceptual and cognitive processes from those required for RetM tasks. At the time of testing, ProM situations engage participants in an ongoing activity (e.g., driving) that may or may not be related to a previously formed intention (e.g., to stop for groceries). Thus, in order to succeed on a ProM task, it is necessary to interrupt the ongoing activity and to switch to the new activity. In a recent investigation, we demonstrated that this interrupting and switching is more likely to occur in experimental situations where the processing required by the ongoing task is closely related to the processing required for recognizing ProM-task-relevant cues (Meier & Graft, 2000). Future investigations will examine whether ProM test performance (i.e., interrupting and switching in response to cues) depends on the level of processing resources that is required for the ongoing task and whether performance declines when the resource pool has been reduced, for example, by age (cf. Darby & Maylor, 1998; Maylor, 1996). Future research will also pose questions about conscious control processes that are unique to ProM: Is a conscious reactivation of a previous intention necessary in order to interrupt an ongoing activity or does the occurrence of the ProM cue trigger the interruption automatically? Is conscious control required for switching from the ongoing to the ProM task? Is ProM impaired in neuropsychological patients (e.g., schizophrenic patients) known to have deficits on switching tasks? Are the brain structures (e.g., prefrontal systems) known to be required for planning, for interrupting ongoing activities, and for switching between activities strongly linked with ProM proper (cf. Burgess & Shallice, 1997; Cockburn, 1995; Shallice & Burgess, 1991)?

These questions about interrupting, switching, conscious control processes, and the resource demands of ongoing activities highlight processing requirements that are unique to ProM. We are convinced that future investigations that focus on these requirements will reveal the evidence called for by Roediger (1996), that is, evidence showing that experimental manipulations or developmental or neuropsychological variables have different effects on ProM and RetM task performance. The commentaries by Roediger and Crowder set the stage for these kinds of investigations by underscoring the need for tasks that are process pure (i.e., tasks that index the probut not retrospective component of performance) and that target that subdomain of ProM that is directly analogous to explicit episodic RetM.

Subdomains of ProM

An intuitive analysis reveals that different ProM activities are associated with different conscious experiences. For example, when waiting to press the record button once a movie resumes on TV, this is a short-term task; it is likely to be kept active in working memory and to dominate conscious awareness. By contrast, if we plan in the morning to get groceries en route from work later in the day, this involves a different type of conscious experience. This plan is not likely to remain active and dominant in working memory; it is out of conscious awareness for most of the reten-

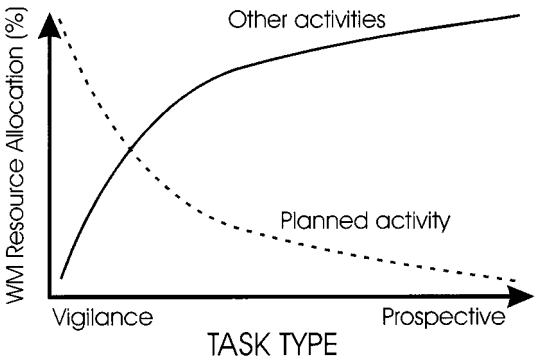

FIG. 1. Resource allocation for vigilance and prospective memory tasks: A conceptual model.

tion interval (i.e., period between making the plan and executing it). Instead, the retention interval is filled with other activities, the ProM task relevant cue (e.g., the supermarket) appears incidentally as a natural part of these other activities (e.g., driving home from work), and what is of interest is whether the cue succeeds in bringing the previously formed plan back into conscious awareness (Einstein & McDaniel, 1996; Kvavilashvili, 1998; Mäntylä, 1996; Meier & Graf, in press).

The different conscious experiences associated with these different prospective activities seem analogous to the experiences that characterize primary and secondary memory tasks, and thus, it seems reasonable to proceed in the spirit of William James's work. James (1890, p. 684) stipulated that ''memory proper'' requires ''the knowledge of an event, or fact, of which meanwhile we have not been thinking, with the additional consciousness that we have thought or experienced it before.'' By analogy, we propose to define *ProM proper* as requiring that we are aware of a plan, of which meanwhile we have not been thinking, with the additional consciousness that we had made the plan earlier. Thus, ProM proper does not encompass the prospective equivalent of primary memory, that is, when a plan or intention remains active in working memory throughout the retention interval. The latter situation is more typical of vigilance and monitoring tasks, and thus, such labels seem more appropriate for the ProM equivalent of primary memory[4] (cf. Einstein & McDaniel, 1996).

We regard vigilance and ProM proper as part of a continuum of possible prospective memory functions (see Fig. 1). At one end of this continuum, the prospective task dominates working memory and conscious awareness during the retention interval. At the other end—the ProM proper end—the plan is out of working memory during

[4] The critical difference between monitoring and ProM proper is not defined by the time interval between instructions and the ProM cue. Monitoring tasks are those where an intention is maintained in consciousness until it needs to be executed. By contrast, for ProM proper, intentions are not maintained in consciousness through the retention interval, while performing an ongoing task. A clear operational distinction between monitoring and ProM proper may be difficult to achieve in each case. However, ProM researchers might go forward as did RetM researchers in the 1960s (when they struggled to find clear operational distinctions between short- and long-term memory) by avoiding boundary cases and instead focus research on unambiguous examples of monitoring and ProM proper.

the retention interval and conscious awareness is focused on competing activities. We postulate that what varies along the continuum is the proportion of available processing resources that are allocated to the prospective task during the retention interval. For vigilance, all or most of the available resources are allocated to the prospective task, whereas for ProM proper, all or most of the available resources are allocated to competing activities. Other tasks, such as waiting for the arrival of a limousine or for the cupcakes to finish baking (see Ceci & Bronfenbrenner, 1985; Dobbs & Reeves, 1996; Harris & Wilkins, 1982), may fall between these extremes; such tasks may recruit a more equal allocation of resources to prospective and other activities.

The domain of ProM proper is further circumscribed by the distinction between episodic and habitual tasks (Harris, 1984; Meacham, 1982), which appears analogous to the distinction between episodic and semantic memory tasks. Buying groceries en route from work is an episodic task, like an episodic memory task, in the sense that the plan arose out of a single event and is to be executed only once. By contrast, taking medication nightly at bedtime is a habitual task, comparable to brushing one's teeth at bedtime. Habitual activities are like semantic memory activities; they have been executed repeatedly and have been shaped by many previous experiences. As these examples illustrate, episodic and habitual tasks are radically different from each other: They arise out of different needs, they are associated with different conscious experiences, and they are marked by different histories (i.e., number of occasions for thinking about and practicing them). For these reasons, by analogy with Tulving's (1972) distinction between episodic and semantic memory, we use the label ProM proper only in reference to episodic or one-off tasks.

We focus attention on ProM proper because this subdomain was indirectly implicated by the commentaries of Crowder and Roediger. We recommend the adoption of clear labels that will increase awareness of distinct subdomains in ProM, that will focus research questions and theoretical accounts more precisely, and that will forestall inappropriate comparisons between an entire domain (i.e., ProM) and parts of another domain (i.e., episodic memory) (cf. Crowder, 1996; Roediger, 1996).

The need for clear labels is further underscored by the difference between *ProM subdomains* and *ProM tasks.* As illustrated above, most current ProM tasks have both a prospective component (e.g., becoming aware of a previously formed plan at the right time and place) and a retrospective component (e.g., recollecting the contents of the plan). Only the first of these components is unique to ProM. For this reason, we use the subdomain label ProM proper only in connection with this component, that is, in the specific sense that is consistent with the functional definition provided earlier in this article. In our view, what is urgently required is the development of instruments and methods that give separate indexes of the pro- and retrospective components of ProM tasks.

Measuring ProM Proper

The vast majority of previous investigations focused on performance of different ProM tasks, such as time versus event based. Thus, despite the fact that the distinction between tasks' pro- and retrospective components is already widely recognized, we

have relatively little direct knowledge about the former component, about ProM proper. What is known about ProM proper is largely indirect, inferred from the findings of task-focused research in which various strategies were used to separate effects due to the pro- and retrospective components (e.g., varying the RetM load across constant ProM conditions and minimizing the RetM load across different ProM conditions; see Einstein et al., 1992; Einstein & McDaniel, 1990). However, the valid and appropriate application of these strategies presupposes an understanding of how the pro- and retrospective components interact with each other, and the absence of this kind of understanding is an additional motivation for future research that focuses on the prospective component.

Is it possible to measure ProM proper directly? For our earlier example, how might we assess whether the cue—the supermarket—encountered en route succeeded in bringing back into conscious awareness the earlier intention to buy groceries? One possibility is illustrated by an investigation of Dobbs and Rule (1987). The subjects were required to complete a questionnaire at home, and the ProM task was to write the time and date in the upper right corner of the form. Dobbs and Rule scored performance in two ways. By a strict criterion, both the time and the date had to be written in the correct location, and by a lenient criterion, performance was counted as successful if either the time or the date were in the correct location. According to Dobbs and Rule (1987, p. 216), the ''lenient criterion provides some measure (albeit not perfect) of remembering to do something [i.e., of ProM proper] while placing minimum requirements on remembering the content of the task.'' Dobbs and Rule found that the strict scores showed only a marginal influence due to age, but the lenient scores showed a significant, substantial age-related performance decline.

To our knowledge, Dobbs and Rule's (1987) study was the first investigation that attempted to estimate ProM proper in this manner, and by their own words, their lenient scores are far from being a perfect measure. However, their approach highlights that ProM proper leaves a distinct signature on responding, and the experimental challenge is to magnify this signature and assess it independently of the RetM component. To accomplish this objective, we recommend using tasks that fit the claim made earlier in this article, that the distinguishing feature of memory's prospective functions is the requirement to identify cues as telltale signs when these occur as a natural part of other thoughts, actions, or situations. In order to execute a previously formed plan in response to a cue, a first step is to stop or pause the ongoing activity, and thus, *the action of stopping or pausing in response to a cue provides an index of ProM proper, of remembering that something needs to be done* (Dobbs & Rule, 1987; Einstein & McDaniel, 1996). Stopping in response to a cue seems independent of the RetM component; it does not guarantee that we remember what needs to be done, just as stopping a colleague in the hallway does not guarantee that we remember the message we intended to convey.

A study by Uttl, Graf, Miller, and Tuokko (2001) illustrates how this approach can be used for obtaining separate measures of the pro- and retrospective components of task performance. The experiment involved a series of attention, perception, and memory tasks. For one of the ProM tasks, subjects were told that in the course of the experiment, when I [the experimenter] say ''this is the end of this task, I would like you to ask for a pen and a piece of paper, and then I would like you to write

your name on the paper.'' Then they performed various activities, at the end of one of which the experimenter said, ''this is the end of this task.'' To indicate that they recognized this cue as a telltale sign, subjects responded to it with comments like ''we need to stop here for another task'' or ''oh, there is something I have to do now'' by explaining that they have to ask for something or by asking for the pen and/or the paper. By this method, we elicited responses to the cue that are indicative of ProM proper, and the results showed that these responses were not dependent on the RetM component, on what needed to be done (see Uttl et al., 2001).

In a recent adaptation of this method, we obtained a continuous index of ProM proper (Graf & Uttl, 1999; Uttl & Graf, 2000). The ProM task was to recall a list of words whenever the ProM cue—a picture of a helicopter—was displayed. The ongoing task required making simple decisions about stimuli that were displayed on a computer screen. For one block of trials, a stimulus containing either an A or a B was shown on the screen for each trial, and subjects made A/B decisions as quickly and accurately as possible. For a second block, the same stimuli were represented, but this time, we also displayed pictures of common objects in the four comers of the screen. The pictures were of different sizes; different pictures appeared across trials, and none of them was a helicopter. Subjects were reminded to make A/B decisions as quickly and accurately as possible. For a third block, everything was as in the second block, except now one of the pictures was the ProM cue. This cue was displayed repeatedly, on about every fourth trial on average, each time in a different screen position. For the first presentation, the cue was relatively small, but it increased in size with for each additional presentation. When a subject detected the cue, they pressed a designated key to stop the ongoing task and to recall the previously studied list. By this method, we were able to use the size of the cue, at the time it was detected, as a continuous index of ProM proper. The results showed that larger cues were required with longer retention intervals (i.e., delays between list learning and ProM cue presentation), even though recall was not affected by the same retention interval manipulation.

Conclusion

ProM has been decreed as a distinctive aspect of memory that forms the logical, natural complement of RetM, that is required for many everyday activities, and whose breakdown may be as debilitating as impairments in RetM. Despite such sweeping claims, however, ProM has received relatively little attention by mainstream memory researchers, and the topic is frequently not even mentioned by introductory cognitive psychology texts. The recent publication of the first book devoted entirely to ProM (Brandimonte et al., 1996) may signal a turn in ProM's visibility, but we are convinced that achieving this goal will require altering the course charted by previous investigations. For this reason, we urge ProM researchers to proceed by identifying distinct subdomains of ProM and to focus research questions and theoretical accounts more narrowly. We recommend that future research should focus on the relationship between ProM proper and explicit episodic RetM. In order to set the stage for this kind of work, we have identified various potential subdomains of ProM and singled out ProM proper as that subdomain that seems most directly analogous to explicit

episodic RetM. We have defined ProM proper both functionally and operationally and illustrated various experimental methods for measuring it.

Because of the unique requirements of ProM proper, we believe that research on the relationship between ProM proper and explicit episodic RetM will contradict the conclusions reached by Crowder (1996) and Roediger (1996), that it will reveal ProM proper as a distinct form of episodic memory. More importantly, we believe that this kind of work will create a closer link between ProM and RetM research and that it will inspire the cross-fertilization of new ideas and new methods for assessing each form of memory as well as the development of new theories for explaining similarities and differences between them. The visibility of ProM proper will be enhanced by evidence that various experimental manipulations or developmental or neuropsychological variables have different effect on ProM proper and explicit episodic RetM.

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